Innovative Learning Environments and Teacher Change
Defining key concepts

Marian Mahat, Chris Bradbeer, Terry Byers & Wesley Imms
The University of Melbourne

iletc

LEaRN
learnetwork.edu.au

THE UNIVERSITY OF
MELBOURNE

Innovative Learning Environments and Teacher Change: Defining key concepts

Lead Chief Investigator
Associate Professor Wesley Imms

Chief Investigators
Professor David Clarke
Dr Ben Cleveland
Associate Professor Kenn Fisher
Professor Lisa Grocott
Professor John Hattie
Professor Thomas Kvan
Associate Professor Clare Newton

Project Manager
Joann Cattlin

Lead Research Fellow/Research Manager
Dr Marian Mahat

Research Fellows
Chris Bradbeer
Dr Terry Byers

Research Assistants
Kirra Liu
Roz Mountain
Lachlan Stewart

Graduate Researchers
Raechel French
Anne Knock
Victoria Leighton
Daniel Murphy
Mark Osborne
Dion Tuckwell
Ethel Villafranca
Pamela Yang
Fiona Young

TECHNICAL REPORT

Innovative Learning Environments and Teacher Change:
Defining key concepts

Ruyton Girls School, Woods Bagot Architecture, Michael Downes - UA Creative.

Overview

Every research project begins with the wish to address a pressing need, and then hopefully transits into a well-resourced active project. ILETC has been fortunate in making the journey from discussions between a few academics, to a successful grant, to the establishment of an extraordinarily skilled and enthusiastic team operating across a number of countries.

A vital component of making such research 'happen' is to logically and progressively build from what we know to what we must find out. Only then can our research effectively address the most pressing questions. ILETC has enjoyed the luxury of an initial 'exploratory' stage where the assumptions and beliefs carried into the project could be tested for their accuracy and relevance. For example, and in reference to ILETC's focus, we assumed that 'innovative learning environments' actually existed in large numbers, and there was some common understanding of their construct and use. We assumed from anecdotal evidence that teachers were tending not to use these spaces as effectively as they could. We assumed that a traditional 'teacher-centric' teaching style was the predominant approach. We assumed that students were continuing to learn 'superficially' as opposed to engaging in the deep learning activities, characteristic of decades of progressive educational theorising and governmental policy aspirations.

These were massive assumptions. We asked ourselves, 'what evidence exists to inform their accuracy?'. During the Phase 1 (exploratory) stage of ILETC, a range of approaches were used to test such assumptions. These included three systematic reviews of the literature, a suite of teacher workshops across Australia and New Zealand, a large survey of primary and secondary school principals, six research events run in Australasia, Europe, and North America, and a series of case studies involving more than 30 schools and other educational sites and 120 teachers, principals, architects and other educators.

What this document is intended to do

The ILETC team collectively set out to define our key terms. If we were to research independently but also within a team of 22 researchers, could we own (as much as is possible) a common understanding of our key terms, and how they were defined? On the surface this appeared to be a reasonably simple task – ask for a literature review from each PhD candidate, and through negotiation conflate the answers. In practice it proved far more challenging. Our multi-disciplinary team (spread across teachers, museum educators, statisticians, designers and architects) each carried their own conceptual understanding of terms such as spatial design, affordances, effective teaching, good learning, and many more. This immersion into our common understanding of terms fostered complex team workshop discussions that addressed many research quandaries hidden in our project; for example: what constitutes evidence?, what actually is 'pedagogy'?, how can we measure for effect?, and how does one understand an individual's 'practice'?. Thus, this report lays out for the team, and interested partners in and consumers of our research, not only stipulative definitions of our key terms, but also how our team determined the critical epistemological foundation required for the next two phases of our project.

What this document is not intended to do.

This Technical Report is not intended to be an extensive literature review covering the identified key terms. Three separate ILETC systematic reviews are undertaking that task in a rigorous way. This report constitutes a literature-based reflection on the team's beliefs about the issues central to our project. As such, it is a discursive piece of writing with commentaries (in boxes beside the text) that comment on the 'facts' unpacked through the literature reviews. It should be read as an ongoing discussion between a large team of enthusiastic researchers from quite differing backgrounds. It is more of a topological survey than a road map. From this document, we have a better understanding of where we are situated in a broad landscape, and will use this knowledge in addition to our other exploratory activities to seek out the roads that transverse that terrain.

A/Prof Wesley Imms
ILETC Lead Chief Investigator
December 2017

Contents

St Michaels Ashburton, Y2 Architecture.

Introduction

The aim of this report is to provide a synthesis of the literature that is relevant to our project and has informed definitions of key constructs. By synthesising scholarly research, together with quantitative findings from the Space, Design and Use Survey (Imms, Mahat, Byers & Murphy, 2017) and qualitative findings from the teacher workshops (Mahat, Grocott & Imms, 2017), this paper advances definitions and characteristics of these concepts pertinent to the current study: *Innovative Learning Environments, Teacher Mind Frames and Student Deep Learning.* In the context of the ILETC project, these key constructs and definitions frame the study and provide a scope to respond to the project's key research question, *Can altering teacher mind frames unlock the potential of innovative learning environments?*

- An Innovative Learning Environment (ILE) is defined in our project as **the product of innovative space designs and innovative teaching and learning practices.** Only when these two phenomena are successfully merged do we produce an innovative learning environment. A design may be deemed 'innovative' but it only becomes an ILE once its inhabitants (teachers and students) teach and learn innovatively within them. Thus we must recognise:

  o **Innovative learning space designs** as being those physical educational facilities designed to facilitate the widest array of flexibility in teaching, learning, and social educational activity. These spaces can be defined across typologies, for example one that our project uses (Dovey & Fisher, 2014) in association with appropriate design affordances. When combined, innovative space designs provide a framework that facilitates, and some might argue catalyses, the fullest array of possible learning and teaching styles.

  o **Innovative teaching and learning practices** are the sum of teaching and learning activities that in combination, firstly assist in the best possible learning outcomes for students, and secondly develop in students the so-called '21st Century learning skills' of creativity, collaboration, communication, and critical thinking. In practical terms for students, these skills should culminate in high levels of deep learning (defined below). In practical terms for teachers, innovative practices are characterised by extensive use of positive mind frames (defined below).

  o **Teacher mind frames** are defined in our project as t**he ways that a teacher actively thinks to guide their professional practice.** In comparison to a teacher's mindset (**the beliefs a teacher holds about teaching and learning**), mind frames are approaches that are actively used in practice – to guide, inform and frame teaching. Teachers enact their mind frames as they consciously think about their teaching roles, the content and pedagogical knowledge, which in turn

have an impact on attitudes, actions and decisions that are likely to have significant impact on student learning. While a teacher's set of mind frames is essentially cognitive and thus behavioural in construct, the possibility exists to treat them as measurable actions. For this project, a schema of low-to-high application of 'favourable' mind frames is used, structured around Hattie's Visible Learning data (2012; Hattie & Zierer, 2017).

- **Student deep learning** is defined in our project as being achieved when **students actively engage in critical learning**. This is characterised by: critically applying new facts to existing knowledge, searching for (as opposed to accepting) meaning, being actively curious about new knowledge, and accepting that learning is a part of their personal development. This contrasts to **student surface or superficial learning** where learning is driven by a wish for acquisition of knowledge that predominately only aids assessment. This definition accepts that deep learning is rarely fully achieved, with students operating across a surface-to-deep learning continuum. Deep learning is often present when students display strong creativity, critical thinking, collaboration, and communication skills – the so-called '4C's. These encapsulate foundational elements for students' success in a highly interconnected, knowledge-based and complex world.

Innovative learning environments

Education is being increasingly called upon to provide a diverse and complex range of systemic responses to global, technological and economic transformations in order to prepare students for their future (Collin & Apple, 2010; Selwyn, 2014). The development of the knowledge society, the drive towards lifelong learning, and rapid shifts in ICT have all prompted a shift towards better understanding the conditions required for students to acquire the skills and dispositions that will enable them to thrive in an increasingly complex society (Fullan & Langworthy, 2014). Furthermore, underpinned by predominant socio-constructivist principles, central to pedagogical models is the understanding that learning is critically shaped by its context, and that it is actively constructed, and collaboratively negotiated (Entwistle, 1977). As a result questions have been raised regarding the type of environment that will most effectively support learning (Entwistle & Brennan, 1971).

The concept of learning environments has emerged as psychological, sociocultural and pedagogical influences have altered the way we perceive the learning context, including the teacher and student roles within it. These influences, some inter-related and some overlapping, have had an impact on how learning environments have evolved.

- Post World War II saw drastic educational reform against totalitarian regimes, which led, in part, to the open-plan movement;

#1
Students need skills that will enable them to thrive in an increasingly complex world.

Learning, and hence its environment, is shaped by its context.

Psychological, sociocultural and pedagogical influences have altered the way we perceive the learning environment.

---

iletc **IMPLICATIONS FOR ILETC**

#1 ILETC must focus on learning environments that promote skills for students to thrive in the 21st century. Learning must respond to educational transformations in an increasingly complex world.

- The influence of psychological ideals and advances in cognitive psychology, for example, Vygotszkian and Dewey philosophies and theories of constructivism (Entwistle, Thompson & Wilson, 1974);
- A shift over time from a teacher-centred, authoritarian approach to a more collaborative, student-centred focus;
- The transformative power of globalization, the economic-focused 'knowledge-economy' developments and technological innovations of the 21st century (World Economic Forum, 2018);
- The advancement of a digital world with ubiquitous technology integration and subsequent user autonomy;
- A reconceptualisation of the fundamental requirements of learning spaces that has rapidly catalysed a perceptual change and consequent movement towards learning spaces that can support digital natives (Entwistle, 1977; Entwistle, Hanley, & Hounsell, 1979); and
- Direct and indirect policy directives, guidelines and reports such as the United Kingdom's Plowden Report (Central Advisory Council For Education, 1967), the Melbourne Declaration on Educational Goals for Young Australians (MCEETYA, 2008), and the design standards for school property (New Zealand Ministry of Education, 2018a) that argue the need for differentiated learning as a core feature of modern educational practices.

Alluded to in early literature as elements that may enhance student learning, such as openness and configurability of space, then later described more definitively through holistic terms like 'modern learning environment' (MLE) and 'new generation learning environment' (NGLE), ILE is the latest aggregate for the experiential and physical innovations that reflect modern contextual influences and the underlying principles representative of 21st century learning. It is noted that changes to learning

#2
There is a confusing array of ILE nomenclature, due to the interplay between the physical and experiential attributes, which must be considered together.

ileTc   IMPLICATIONS FOR ILETC

#2 ILETC must articulate the observation that ILEs are not a revolution but part of the incremental and iterative development of spatial design and innovative practices. While ILE is a more contemporary term, the concept of it has evolved over many years due to psychological, sociocultural and pedagogical influences.

environments, however, is not a 21st century revolution but simply an iteration of years of spatial design and development of educational theory and practices (Imms, in press).

Although a relatively youthful educational discourse, the field of ILEs has become quickly peppered with nomenclature that at times has become confusing. The definition of ILEs varies internationally, influenced by national and local government policies, school systems, architects, education planners, teachers, students and parents' expectations and preferences. For instance, the ILE terminology has been appropriated and deconstructed to separate property attributes from the broader school context. Yet it must be understood, that these interplaying aspects, physical or experiential, should be considered together in the context of the ILE.

The OECD (2011) defined an "educational space" as "a physical space that supports multiple and diverse teaching and learning programmes and pedagogies, including current technologies; one that demonstrates optimal, cost-effective building performance and operation over time; one that respects and is in harmony with the environment; and one that encourages social participation, providing a healthy, comfortable, safe, secure and stimulating setting for its occupants" (pp. 1-2). Over time, 'education space' has been re-termed ILE, and the definition shifted to encapsulate the notion that an ILE is not easily defined by specific parameters, but rather, by the experiential principles and values embodied in their design. As a result, the focus on ILEs is on the interrelationships and dynamics between experimental attributes. Learners, teachers and learning professionals, learning content, as well as resources including facilities and technologies, are all seen as elements that make up what Dumont, Istance, and Benavides (2010) refer to as the 'pedagogical core'. In addition, sustainable innovative practices are determined to require vision and strategic leadership, as well as broader ongoing connections with partnerships extending beyond the boundaries of traditional learning environments (OECD, 2015). Taken as a whole, it is this interconnectedness that is seen to foster conditions for sustainable innovation. Emphasising this, the OECD (2017) updated its definition of a "learning environment" as:

IMPLICATIONS FOR ILETC

#3 ILETC must focus exclusively on teacher practices in ILEs. The OECD has, for many years, made a massive investment to better understand ILEs. Their definition of ILEs has evolved to refer to an organic environment with a pedagogical core. The concept of ILEs as a 'pedagogical core' is a significant gap that ILETC will address.

- an organic whole embracing the experience of organised learning for given groups of learners around a single "pedagogical core"; it is larger than particular classes or programmes;
- includes the activity and outcomes of learning, rather than being just a location where learning takes place; and
- enjoys a common leadership making design decisions about how best to optimise learning for its participants.

Governments, globally, have used different labels and definitions to describe ILEs. The Ministry of Education in New Zealand, for instance, defines an ILE as "one that is capable of evolving and adapting as educational practices evolve and change – thus remaining future focused" (2018). They renamed MLE to ILE in order to be 'consistent with both international usage and growing discomfort in New Zealand with the term MLE' (New Zealand Ministry of Education, 2018b).

An ILE can be defined as the complete physical, social and pedagogical context in which learning is intended to occur (Osborne, 2016). It is therefore difficult to establish distinct, specific regulations or standards for defining physical features of ILEs since they are so inextricably linked with the social and pedagogical contexts. Their physical design exemplifies a set of ideal principles, and it is the interplay between these principles and the physical entities that embody them that is most important.

> An ILE can be defined in terms of its physical, social and pedagogical contexts.

Some key features, most notably mentioned in the literature, that characterise ILEs are those that enhance student-centredness (Blackmore, Bateman, Loughlin, O'Mara, & Aranda, 2011; Istance, 2018; Marton & Säljö, 1976) through flexibility in the physical space and associated malleability in pedagogical practice (Butin, 2000; JISC, 2006; Leiringer & Cardellino, 2011; OECD, 2006), personalisation of learning (Chism, 2005), collaboration (Ramsden & Entwistle, 1981), the

> An ILE is defined by practices that enable student-centred learning.

> #4
> An ILE is flexible, providing for a variety of teacher and pedagogical practices.

IMPLICATIONS FOR ILETC

#4 ILETC must differentiate between open plan and flexible learning environments. While ILEs have been associated with the open plan movement of the 1960s, an ILE in not synonymous with being open plan.

development of real-world skills for example technological fluency (Ramsden & Entwistle, 1981) and future-readiness (OECD, 2006; Ramsden & Entwistle, 1981). The OECD also lists boldness, creativity, the ability to provide support and the potential to be enterprising as integral to ILEs (OECD, 2006).

Additionally, EDUCAUSE advocates innovative learning environments that promote more active connections with digital learning (Lomas & Oblinger, 2006). According to Lomas and Oblinger (2006), classrooms with ubiquitous access to technology bring additional capabilities and can engage students in learning. These features include:

- Digital – acknowledging that technology is a way of life for contemporary students;
- Mobile – enabling the interconnection of multiple devices;
- Independent – acknowledging the self-reliance of today's students;
- Social – enabling students to work and collaborate in virtual social groups; and
- Participatory – recognising that students may participate with global connections.

Regardless of the labels and definitions used, research suggests that an effective learning environment, is one that:

- makes learning and engagement central;
- ensures learning is social and often collaborative;
- is attuned to learners' motivations and emotions;
- is acutely sensitive to individual differences;
- is appropriately demanding for each learner;
- uses assessments that are consistent with its aims, with a strong focus on formative feedback; and
- promotes connectedness across activities and subjects, in and out of school (Dumont & Istance, 2010).

With research increasingly recognising the importance of physical space in educational settings (Beare, 2001; Buckley, Schneider, & Shang, 2005; Clarke, 2001; Edwards & Clarke, 2002; Fisher, 2005; Higgins & Reeves, 2006; Lackney, 1999; Monahan, 2000), reconfiguring learning spaces based on the above principles has become the underpinning framework of ILE design. Since space is acknowledged to have an undeniable influence in shaping psychological and social practice (Lefebvre, 1991; Massey, 1994; Massey, 2005), it is likely that designing space with 21st century learner intentions will have subsequent effects on pedagogical practice and student learning (Oblinger & Lippincott, 2006; Sanoff, 1995). Early examples of this can be seen in the Reggio Emilia conception of

An ILE enables development of real-world skills or students' deep learning characteristics.

An ILE develops technology-ready skills for students that enhance their mobility, independence, and social and global participation.

the physical environment as 'the third teacher' (Rinaldi, 2006), which acknowledges that the physical layouts of classrooms represent symbols for educational expectations and philosophies (Bateman, 2009).

However, Boys (2009) argues that the presence of physical symbols of changing practice, such as those representative of informal learning: bean bags, learning cafés, corridor 'nooks' and soft furnishings, may represent a disconnect between the intent of the design and outcome if the interactive dynamic between the social, psychological and pedagogical influences within the space are not acknowledged. Further, examination of the causation between ILEs and their capacity to enact pedagogic change has revealed a weakness of causality in most cases (Mulcahy, Cleveland, & Aberton, 2015). That is, creating a space is not integrally related to generating behavioural change, as "space is not a thing but a process" (Boys, 2009, p. 5). ILEs may then be loosely "defined not only by their open-plan architectural designs and movable furniture and fittings, but also for the changes they bring about to teaching and learning practices" (Saltmarsh Chapman, Campbell, & Drew, 2015, p. 316).

An assumption in some of the ILE literature is that open-plan classrooms, by removing or reconfiguring walls, break down existing teacher power structures and increase student empowerment and collaboration (Chapman, Randell-Moon, Campbell & Drew, 2014). However, contention exists as to whether open-plan settings can support the learning needs of students. This is particularly pertinent considering the poor acoustics of newly opened classrooms during the open-plan movement of the 70's. The reported negative impact of 'noise' on the cognitive and socio-emotional development of children (Elliott, 1979; Johnson, 2000; Klatte, Hellbrück, Seidel, & Leistner, 2010; Nelson, Kohnert, Sabur, & Shaw, 2005; Soli & Sullivan, 1997; Stelmachowicz, Hoover,

For decades, Reggio Emilia has pre-empted current conversations about the 'active teaching' role space plays.

#5
ILEs may bring about changes in teaching and learning practices but there may be a disconnect between design and practice that fails to generate behavioural change.

#6
The importance of acoustics in school design came to the forefront when cultural change in the 70s prompted drastic educational reforms, leading to the introduction of open-plan classrooms in many schools.

IMPLICATIONS FOR ILETC

#5 ILETC must explore the 'agent versus catalyst' debate of ILEs. Are ILEs, by virtue of their presence, a catalyst for 21st century learning? Or must teachers consciously treat ILEs as one agent to support pedagogy? Or is it a combination of the two?

#6 ILETC must articulate the importance of acoustics in learning environments. How much do teachers know about acoustics?: how might increased knowledge lead to a better physical, acoustical environment?

Lewis, Kortekaas, & Pittman, 2000) and student learning (Akhtar, Anjum, & Iftikhar, 2013) saw a lot of the walls re-erected, and these spaces reconverted to closed, traditional classrooms. Nevertheless, the evolution of acoustics over 50 years and unwavering associations of openness with freedom has seen a recent resurgence of research into open-plan spaces. The removal of classroom walls has shown to enable personalised learning and enhance student wellbeing through new affordances that facilitate flexible groupings, task dependent space diversification and opportunities for increased interactions, team-teaching, collaboration, and closer relationships between students (Prain et al., 2015).

The concept of openness is further explored in the Dovey and Fisher classroom typologies, which describe five different classroom types, increasing in openness

'A'   'B'   'C'   'D'   'E'

TRADITIONAL
Learning spaces

- - - - - - - - Bi-folding wall

————— Solid wall

OPEN-PLAN
Learning spaces

■ Store room   ■ Classroom   ■ Street-space   ■ Commons

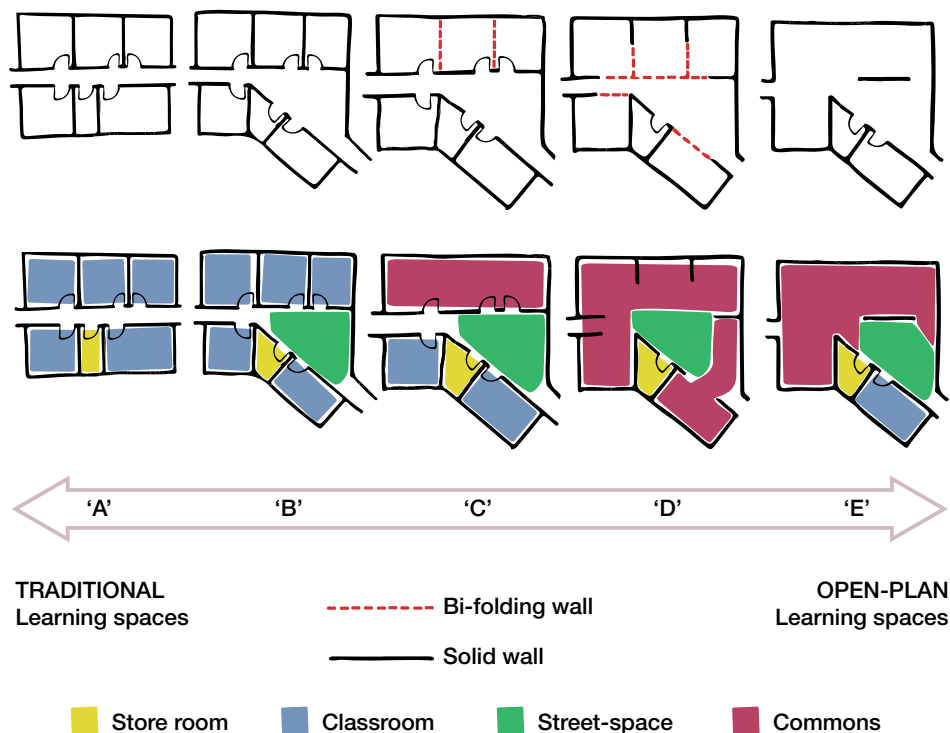Figure 1: Dovey and Fisher's (2014) learning spaces type, as adapted in Imms, Cleveland and Fisher (2016).

IMPLICATIONS FOR ILETC

#7 ILETC must define the concept of affordances in the context of the project. The concept of affordances provides a useful framework to understand spatial environments, however the term has been developed predominantly through other disciplinary fields, for example environmental psychology.

and with varying configurability from traditional to open-plan as the diagrams extend from left to right (see Figure 1). The capacity of the physical space to convert between different arrangements (configurability) to allow a multitude of spaces and consequently varied learning activities to take place with ease is referred to as 'agility' and 'fluidity' by Dovey and Fisher (2014). Interestingly, they found that the most open of the typologies did not pertain to the greatest configurability (Dovey & Fisher, 2014), suggesting that complete openness is not the standard. Rather the configurability and potential for varied task-specific settings, through manipulation of the physical space, with moveable walls, blackboards, interactive whiteboards and other dividers, may be more desirable. This finding concurs with results of a survey concerning the types and use of learning spaces in Australian and New Zealand schools. Drawing on the Dovey and Fisher typology, the results of the Space, Design & Use (SDU) survey found that schools with a higher prevalence of Type D space (see Figure 2) reported a higher assessment along the teacher mind frame and student deep learning continuum (Imms, Mahat, Byers & Murphy, 2017).

Flexibility with configurability and diversity in furniture, such as varied heights of tables and chairs, stools, café nooks, bean bag lounge areas,

> **#8**
> Each typology of space brings task-specific settings that are desirable for specific outcomes. The implications of each must be articulated.

> **#9**
> Initial evidence on the impact of space on student deep learning and teacher mind frames is emerging.
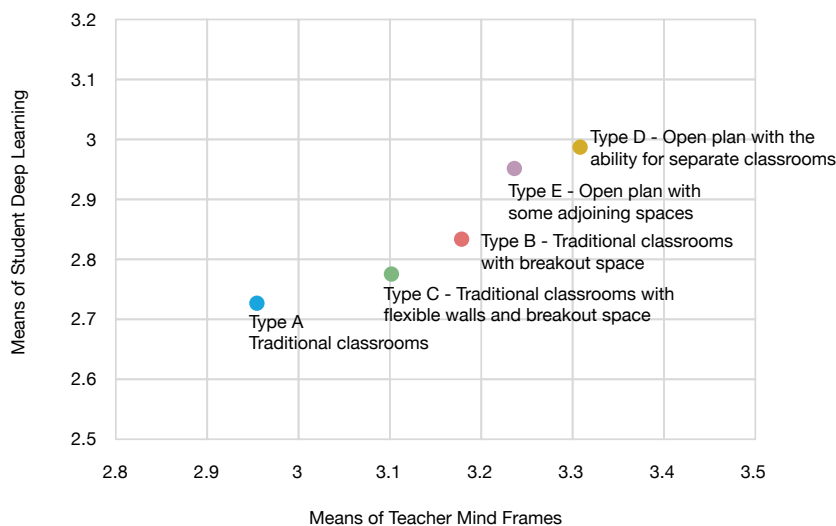
Figure 2: Means of teacher mind frames and student deep learning categorised by most prevalent learning environment type (Source: Imms et al., 2017).

IMPLICATIONS FOR ILETC

#8 ILETC must explore the spatial implications of each typology of space. What are the acoustic implications in each typology of space? What about furniture? Technology? How then do teachers use their understanding of each spatial aspect to achieve the desired learning?

#9 ILETC must further validate the impact of each typology of space on student deep learning and teacher mind frames. Robust measurements of each will provide the much needed evidence of the impact of innovative learning environments.

reading coves and soft modular furniture, is also seen to heighten the potential for task variety by creating a multitude of different pockets that accommodate a wide range of learning groups (individual, small group, large group, whole class instruction) with different learning styles (Dudek, 2000; Oblinger, 2006). Consequently, this also flows into pedagogical flexibility, as these environmental facets may be altered to accommodate or catalyse evolving pedagogies (Butin, 2000; Dudek, 2000; JISC, 2006). For example, a study by Neill and Etheridge (2008) which followed the renovation of a traditional space into a flexible learning environment saw increased engagement, collaborative learning, the capacity for diversity in usage, and enriched teaching and learning styles. Learning environments that are flexible are seen as being "more open than traditional classrooms and can often accommodate more than one class and several teachers. They are often made up of many different sized spaces so they can support different ways of teaching and learning and be used for different types of activities. Many spaces have glazing between them to create open and light spaces that can be indirectly supervised." (New Zealand Ministry of Education, 2015b).

Inherently interlinked with ideas of flexibility are principles of personalisation, collaboration and student-centredness; altering space and furniture to accommodate and cater for the learner's needs encompasses all these principles. The omnipresent and pervasiveness of technologies alone, have been shown to not only increase flexibility, personalisation and collaboration but also, student engagement (Dwyer, Ringstaff, Haymore, & Sandholtz, 1994; Rowe, Shores, Mott, & Lester, 2011; Smith, 2014), persistence (Czarapata & Friskney, 2014), opportunities for polysynchronous designs (Akhtar et al., 2013), deep and authentic learning (Royle, Stager, & Traxler, 2014), dissemination of information, and connection with experts, teachers and other students. Further, Blackmore et al. (2011) note that much of the literature on flexible design through classroom layout and furniture positioning focuses on "ideal patterns and designs characterised by flexibility and mobility of structures, the grouping of desks, computer pods and display boards in order to facilitate multimodal pedagogies that accommodate individual learners' needs, and personalisation of space." This is reaffirmed by McLaughlin and Faulkner (2012) who report that students prefer flexible learning spaces that are adaptable and can be altered to facilitate both individual and collaborative group work with infused technologies. However, while boasting clear benefits in much of the literature, the contention of certain physical principles and their effectiveness has been a looming cloud over productivity in ILEs as the transition from design to a functional space has seen many fall short of their initial intention. This may be explained by the disconnect between designers, researchers and educators alike, since space and what it contains, is more than the easily visualised physical foundation.

Ideas of personalisation, collaboration and student-centredness are linked to flexibility.

There is a critical need to include educators' perspectives within ILE design.

Built educational space forms only one integral component of a learning environment. Leveraging the application of design principles and linking these to pedagogical outcomes and spatial affordances, an ILE can be seen as one that is capable of evolving and adapting as educational practices continue to transform.

IMPLICATIONS FOR ILETC

#10 ILETC must consider more than just the physical environment. The physical design of space is only one component of any learning environment. ILEs can also be defined by the changes they bring about to teaching and learning activities.

Defining an ILE in the context of the ILETC project

The literature on learning environments has had a short history that can be traced back to Post World War II. As yet, there is no consensus as to what constitutes an ILE. The literature seems to suggest that an ILE is shaped by its context and is influenced by psychological, sociocultural and pedagogical stimuli. An ILE is one that encourages flexibility for a variety of teacher and pedagogical practices that enable student-centred learning. An ILE enables students to acquire skills, including technological ones, and deep learning characteristics that will enable them to thrive in an increasingly complex world. An ILE enables shared leadership on how best to optimise learning for students.

The Space, Design and Use Survey, developed in phase 1 of the ILETC project (Imms, Mahat, Byers & Murphy, 2017) utilised the five typologies of spaces as conceptualised by Dovey and Fisher (2014). Results seem to indicate that, up to a particular level, as the space becomes more physically open, student deep learning seems to increase. It is notable that a reverse trend is seen as spaces move towards the 'fully open' arrangement. This would suggest that a space that is innovative opens up more opportunities for student to develop skills required for an increasingly complex world.

Teacher workshops conducted in Auckland, Brisbane, Canberra, Christchurch and Sydney seem to indicate that teachers perceive a learning environment as being innovative when it allows for teacher practices to change in order to support student-centred learning (Mahat, Grocott & Imms, 2017). Specifically, participants from the Sydney workshop defined an ILE as one with adaptable spaces and ubiquitous resources and technologies, which can evolve and change to support transitions between different types of student-centred learning.

Triangulating the literature review with results of the survey and teachers' insights from the workshop, an ILE can be defined as the product of innovative design of space and innovative teaching and learning practices. Innovative learning spaces are physical educational facilities designed and built to facilitate the widest array of flexibility in teaching, learning, and social educational activity while innovative teaching and learning practices are the sum of teaching and learning activities that in combination assist in the best possible learning outcomes and learning skills of students required in the 21st century. An ILE is produced when these two phenomena are successfully merged.

Nordagerskolen, Charlotte Folke Architecture/Ecophon Saint Gobain, Teddy Strandqvist photography.

Teacher mind frames

Teachers have a significant influence on the classroom learning environment, and hence, the student learning that occurs within it (Tobin, 1990; Rowe, 2003). This impact is dependent on the stable preformed cognitive characteristics of the teachers that the students interact with, since ways of thinking will inform teachers' decisions, and hence, their behaviour and practice (Clark & Yinger, 1977; Hattie, 2012).

Research on teachers' thinking and how it impacts behaviour have had a long history which is interdisciplinary in nature that covers human decision-making process, problem-solving, psychological, to name a few. Reflected in this varied research is the suite of terms that has been used to describe teachers' thinking or the notion of teachers' cognition such as attitudes, values, judgments, axioms, opinions, ideology, perceptions, conceptions, conceptual systems, preconceptions, dispositions, implicit theories, explicit theories, personal theories, internal mental processes, action strategies, rules of practice, practical principles, perspectives, repertoires of understanding, social strategy, teaching criteria, principles of practice, personal construct/theories/epistemologies, teachers' conceptions, personal knowledge, practical knowledge (Pajares, 1992, p. 309). Consequently, research focusing on the impact of teacher thinking on student learning and achievement has been particularly perplexing due to varied understanding and conceptualisations, and a lack of ubiquity and universality in defining the cognitive processing of teachers (Pajares, 1992).

Possibly the most commonly cited term in the literature is 'teacher beliefs', broadly defined as "tacit, often unconsciously held assumptions about students, classrooms, and the academic material to be taught" (Kagan, 1992, p. 65). There is vast evidence in the literature that teachers display an "eclectic aggregation" (Clark, 1988, p. 6) of implicit beliefs and theories that influence their practice (Brown & Cooney, 1982), and these "play an important part in the judgments and interpretations that teachers make every day" (Clark, p. 6). Further, teacher beliefs form part of an individual's larger belief system which comprise the

> Teachers have the greatest impact on student learning and outcomes. However, it is not teaching itself, but the learning that teachers elicit that is key.

> A suite of terms has been used to describe teachers' thinking, cognition or thought processes.

> 'Teacher beliefs' is the term most commonly used to describe the broad, implicit and unconsciously held assumptions about students, classrooms and content knowledge.

highly intertwined notions of attitudes and values. Attitudes refer to the holistic organisation "when clusters of beliefs are organised around an object or situation and predisposed to action" (Pajares, 1992, p. 314) and values, "which house the evaluative, comparative, and judgmental functions of beliefs and replace predisposition with an imperative to action" (Pajares, 1992, p. 314).

Although Tobin (1990) put the onus of learning on students, he also asserted that teachers have a direct influence on the context in which classroom learning happens. There are cognitive factors such as metaphors used to conceptualise teaching roles, content knowledge and pedagogical knowledge that can directly influence the manner in which teachers structure the learning environments. These cognitive factors he referred to as "teacher mind frames" (Tobin, 1990, p.34).

Although not the first to coin the term mind frame, the notion of teachers' mind frames has been linked to Hattie (2009; 2012). He performed a meta-analysis of over 800 studies relating to student achievement (2009) and found that a teacher's mind frames is the mediating variable that directs how he or she thinks and acts when engaged in all aspects of teaching. Drawing on Hattie's work, Beere (2013) used the term mind frames and mindsets interchangeably and defined them as "the ways in which we think about the world and which affects our attitudes and actions" (p. 9). Looking broader into the literature, mindsets can be defined as a series of self-perceptions or beliefs people have about themselves (Dweck, 2006). This can be distinguished from mind frames, which is the beliefs teachers have about the world.

Hattie's foundational synthesis presents eight teacher mind frames, that most commonly underpin the actions and decisions made in schools that are necessary to maximise student learning, firmly stating that the beliefs and commitments of teachers are the "greatest influence on student achievement over which we can have some control" (Hattie, 2012, p. 25). These eight teacher mind frames were used in the Space, Design & Use Survey in phase one of the ILETC project (Imms et al., 2017). More recently, Hattie and Zierer (2017) re-organised and updated Hattie's original teacher mind frames. These (now ten) mind frames, although notably revised, continue to be founded on the principle that teachers are evaluators, change agents, learning experts, and seekers of feedback who are constantly engaged in dialogue and challenge (Hattie & Zierer, 2017). The first three mind frames relate to impact, the next two to change and challenge and the last five to learning focus. An overview of each follows, which is based on Hattie & Zierer's most recent book (2017):

Teachers' cognition is used to conceptualise teaching roles, content knowledge and pedagogical knowledge.

Based on a meta-analysis of over 800 studies, the term 'teacher mind frame' emerged as a more holistic term to describe teachers' thought processes.

Mind frames describe the ways in which we consciously think about the world and which affect our attitude and actions.

Mind frames underpin actions and decisions of teachers that are likely to have significant impacts on student learning.

Ten mind frames direct how teachers engage in all aspects of teaching.

Impact

1. I am an evaluator of my impact on student learning.

2. I see assessment as informing my impact and next steps.

3. I collaborate with my peers and my students about my conceptions of progress and my impact.

Change and Challenge

4. I am a change agent and believe all students can improve.

5. I strive for challenge and not merely "doing my best".

Learning Focus

6. I give and help students understand feedback and I interpret and act on feedback given to me.

7. I engage as much in dialogue as monologue.

8. I explicitly inform students what successful impact looks like from the outset.

9. I build relationships and trust so that learning can occur in a place where it is safe to make mistakes and learn from others.

10. I focus on learning and the language of learning (Hattie & Zierer, 2017, p. v).

> *#11*
> TMF1: Teachers evaluate their impact on student learning.

The core message of mind frame 1: 'I am an evaluator of my impact on student learning', is that educational expertise is demonstrated by how teachers think about what they do. Teachers who exhibit this mind frame believe that their fundamental task is to evaluate the effect of their teaching on students' learning and achievement. Hattie and Zierer (2017) proposed that formative (as compared to summative) evaluation has a higher impact on student learning (with an effect

---

IMPLICATIONS FOR ILETC

#11 ILETC must consider the spatial aspects of the teacher's role as an evaluator of impact (TMF1). The flexible learning environment provides unique opportunities for teachers' reflexive and reflective practice. Teachers must constantly consider the learning implications of the learning environment, for instance:

- *how to build students' capacity to make learning related spatial choices;*
- *how students and teachers choose particular spaces for particular tasks; and*
- *how they facilitate student groupings and collaborative practices by using specialised spatial affordances.*

For teachers to include a spatial aspect to their role as an evaluator of impact, they require:

- *a well-articulated construct of teacher and student 'spatial competencies';*
- *a useable 'typology of affordances' so they can quickly adapt pedagogies to suit emerging learning;*
- *mechanisms to evaluate how different affordances impede or assist student learning; and*
- *develop capacity to evaluate spatial impact (formally/informally).*

size of 0.90). This form of formative evaluation is conducted during an intervention (Scriven, 1967), allowing the teacher to use the resulting data to direct and evaluate their actions and efforts accordingly (Locke & Latham, 1990) and hence bring about continuous performance improvement of the students during the intervention. For example, in one meta-analysis of children with mild learning difficulties, teachers that produced progress graphs of individual students reported consistently higher mean effect size gains than those who chose not to (Fuchs & Fuchs, 1986). The objective is to make a teacher's impact on student learning visible at the end of the lesson. This can be done through diagnosis of what each student brings to the lesson, having multiple interventions such that this can be substituted if required, having quality implementation of any interventions, and evaluating the impact of the interventions (Hattie & Zierer, 2017, p. 8). Hattie and Zierer (2017) distinguished this evalutation from the notions of assessment and feedback (for a full dicussion, see Hattie & Zierer, 2017, p. 5-6).

Mind frame 2 is about seeing assessment as informing impact and next steps. This mind frame sees student achievement as feedback about teachers and for teachers. Assessments can allow teachers to evaluate the efficacy and impact of their teaching on student learning and achievement. Assessment is more than providing teachers with subsidiary figures to enable ranking and comparison, but is an 'instructional tool' that enhances student learning and provides teachers themselves with feedback they can utilise to revise and personalise instruction (Chappuis & Stiggins, 2002; Leung & Mohan, 2004). In addition, teachers that endeavour to promote continuous learning within themselves through constant evaluation and feedback are more likely to be successful (Katzenmeyer & Moller, 2009), feeding into Hattie's mind frame 6 that feedback for teachers is one of the biggest influences on student learning.

#12
TMF 2: Teachers see assessment as informing their impact and planning.

---

iletc   IMPLICATIONS FOR ILETC

#12 ILETC must consider the spatial aspects of the teacher's role to assess their impact (TMF2). The flexible learning environment provides teachers unique opportunities to identify and evaluate change to actively promote student learning. Teachers must consider:

- *the use of technology as one mechanism to assess the impact of their practices in enhancing student learning; and*
- *the capacity for evidence to enact improvements.*

For teachers to include a spatial aspect to their role as an evaluator of their impact, they require:

- *spatial competencies to continually adjust the space and the lesson to match the current learning level of the students;*
- *multiple methods of measuring and triangulating data to assess their impact on student learning; and*
- *knowledge of how spatial affordances present opportunities to meet a range of learning needs.*

Mind frame 3, 'I collaborate with my peers and my students about my conceptions of progress and my impact', encourages exchange and collaboration. Teachers who demonstrate this mind frame believe that teachers who collectively think about their impact and student progress are most relevant to the success of their students (Eells, 2011). Hattie & Zierer (2017, p. 28) advanced nine steps toward the development of mind frame 3: (1) an understanding of 'I cause learning'; (2) agreeing that "we are jointly responsible for each student"; (3) seeking to evaluate the impact of teaching; (4) having the 'I' and 'We' skills; (5) working with others to seek evidence of impact; (6) working with others to agree on sufficient and high levels of growth; (7) focusing on excellent diagnosis of student learning; (8) working and evaluating together with colleagues to have a common conception on progress; and most importantly (9) having school leaders create and support a culture of collective efficacy .

IMPLICATIONS FOR ILETC

🛈 *#13 ILETC must consider the spatial aspects of the teacher's role to collaborate with their peers and students (TMF3).* The flexible learning environment provides teachers unique opportunities for teacher-teacher, teacher-student and student-student collaboration. In order to actively promote collaboration, teachers must:

- *develop understanding of collaborative approaches to learning and teaching;*
- *develop an approach to modelling, feedback and mentoring between teachers; and*
- *share a common understanding of potential challenges and opportunities.*

For teachers to include a spatial aspect to their role as a collaborator, they require:

- *spatial knowledge about the scope of collaborative possibilities and opportunities embedded in their learning environment;*
- *guidelines for practical ways to embed collaborative practices into existing teaching practices in existing learning environments; and*
- *a mapping of space and furniture configurations and typologies, with evidence of their impact on collaboration.*

'I am a change agent and believe all students can improve' is mind frame 4. Researchers such as Bybee (1993), Fullan (1993) and Hill (1971) assert that teachers are and should be 'change agents' and that their beliefs are crucial in facilitating reform at both classroom and school levels— not as facilitators, developers or constructivists (Hattie, 2012). In their meta analyses synthesizing 164 studies, Alfieri, Brooks, Aldrich, and Tenenbaum (2011) found that the outcomes for assisted discovery were more favourable than both explicit instruction and other instructional methods, reinforcing that teachers are agents of change and that "feedback, worked examples, scaffolding, and elicited explanations" (Alfieri, Brooks, Aldrich & Tenenbaum., 2011, p. 12) enhance learning. Hattie and Zierer (2017) proposed a number of strategies for developing agency: using a variety of classroom management strategies, using preventive strategies to deal with disruptive behaviour, building a critical mass of learners, developing learning pathways, and complementing feedback with appropriate assessment methods.

#14

TMF 4: Teachers are change agents and believe all students can improve.
(*see next page*)

◢iletc IMPLICATIONS FOR ILETC

⊙ *#14 ILETC must consider the spatial aspects of the teacher's role as an agent of change (TMF4).* The flexible learning environment provides teachers unique opportunities to be creative and ambitious when structuring learning. In order to actively promote better learning, teachers must consider:

- *the scope of learning possibilities/affordances embedded in their learning environment;*
- *the capacity of these spatial characteristics to engage, challenge and extend students' learning; and*
- *that 'spatial efficacy' (mastering the capacities of the built environment) increases the impact of good pedagogies.*

For teachers to include a spatial aspect to their role as an agent of change, they require:

- *a mapping of past spatial interventions done by teachers, together with evidence of their impact on student learning;*
- *guidelines for practical ways to embed innovative spatial interventions into existing teaching practices in existing learning environments; and*
- *a mechanism to quickly evaluate how changes in use of space impact students' learning.*

Mind frame 5 is about making learning challenging. "I strive for challenge and not merely 'doing your best'" is about developing challenging assignments based on learning levels, and challenging learning goals on the basis appropriate to the students' learning needs. As educators, teachers should evaluate whether their practices are bringing out the best learning in students. If teachers are able to set goals that challenge students in an appropriately scaled way, and 'enjoy the challenge and never retreating to just 'doing their best', Hattie (2012) argues that there could be significant student achievement yields. This is reinforced in Locke and Latham (1990) meta-analysis of nearly 400 studies which reveal that specific, difficult goals lead to better performance (Locke & Latham, 1990).

IMPLICATIONS FOR ILETC

#15 ILETC must consider the spatial aspects of the teacher's role to transform practices and pedagogy (TMF5). The flexible learning environment provides teachers unique opportunities to modify practices and pedagogy when structuring learning. In order to do this, teachers must:

- *develop a practice of reflecting and sharing their learning regarding space and its affordances;*
- *be given the opportunities to try the range of teaching and learning possibilities embedded in their learning environment;*
- *understand the capacity of these spatial characteristics to engage, challenge and extend their teaching practices; and*
- *have the knowledge of how 'spatial competencies' increase the impact of good pedagogies.*

For teachers to include a spatial aspect to their role to transform practices and pedagogy, they require:

- *an understanding of the affordances of space in developing good pedagogies; and*
- *a range of spatial competencies that enacts teachers' ability to think 'outside the square' when modifying practices in the learning space.*

With an average effect size of 0.75, feedback can be powerful or harmful, as the variance of the impact of feedback is among the highest of all education influences (Hattie & Zierer, 2017). Mind frame 6, 'I give and help students understand feedback and I interpret and act on feedback given to me' relates back to mind frame 2 which views assessment, and consequently student achievement, as feedback for teachers. Teachers who demonstrate mind frame 6 provide deliberate, well-considered and purposeful feedback at different levels—task, process and self-regulation—and different perspectives—past, present and future— depending on where the student is on the learning cycle (see Table 1). This should necessarily encompass teacher-to-student, student-to-teacher and student-to-student (teacher-teacher?) feedback. Effective feedback must also answer three major questions: Where am I going?, How am I going? and Where to next? (see also Hattie & Timperley, 2007).

Table 1: Levels and perspectives of feedback (Source: Hattie & Zierer, 2017)

		Levels of feedback		
		Task	Process	Self-regulation
Perspectives of feedback	Past ("feed back")	What progress has the learner made on goal and content?	What progress has the learner made on task completion? Is there evidence of improvement?	What progress has the leaner made on self-regulation strategies?
	Present ("feed up")	What goals did the learner reach? What content did the learner understand?	How did the learner complete the task? Is there evidence of how the learner worked?	What self-regulation strategies did the learner successfully apply?
	Future ("feed forward")	What goals should be set next? What content should be learned next?	What tips on task completion should the learner be given next?	What self-regulation strategies should the learner apply next?

IMPLICATIONS FOR ILETC

#16 ILETC must consider the spatial aspects of the teacher's role to seek, provide and understand feedback (TMF6). The flexible learning environment provides unique opportunities for teachers to develop feedback mechanisms when structuring learning. In order to do this, teachers must consider:

- *enabling a learning environment that is conducive to providing and receiving feedback;*
- *using technology as one mechanism for providing and receiving feedback; and*
- *ensuring teaching practices are aligned with the intended learning outcomes.*

For teachers to include a spatial aspect to their role to seek, provide and understand feedback, they require:

- *regular feedback mechanisms integrated into the learning environment and their teaching practices;*
- *multiple methods of providing and receiving feedback including student achievement data to assess the impact of their teaching; and*
- *a shared language with leaners to enable feedback on spatial choices and preferences.*

Mind frame 7 states that if teachers engage in dialogue with another person—other learners, teachers or parents—this will have a beneficial influence on the learning outcomes of students. Mind frame 7, 'I engage as much in dialogue as monologue' is about encouraging students to talk about content as well as leading students to learning success through cooperating with others. In a case study of a teacher which aimed to portray 'Ellen's' thinking and how she sees her teaching in her "idiosyncratic teacher's world" (Munby, 1984, p. 38), it was found that the "back and forth gab" (Munby, 1984, p. 32) between Ellen and her students was integral in trying to make students feel successful at school. Hattie and Zierer (2017, p. 112) reiterate that there are many ways to enhance the levels of dialogue in classrooms, and this should be led by evidence of learning and the guiding principle "know thy impact"

'I explicitly inform students what successful impact looks like from the outset' is mind frame 8. The core message in this mind frame is that "successful learning requires clarity – not only in the learning process but also in view of the learning outcome" (Hattie & Zierer, 2017, p. 118). The visualisation of learning objectives and success criteria can lead to learners: having a better understanding of where they are in the learning process, being responsible for their learning, having self-confidence and self-efficacy about their ability, developing realistic expectations of themselves, and moving from superficial to a deep understanding. Hattie & Zierer (2017) assert that the success of schools and students is a result of effective communication and understanding of the success criteria in the learning process.

iletc   IMPLICATIONS FOR ILETC

#17 ILETC must consider the spatial aspects of the teacher's role to engage in dialogue about students' learning (TMF7). The flexible learning environment provides teachers unique opportunities to listen and be proactive in encouraging students as agents of their own learning. In order to do this, teachers must:

- *articulate the benefits of cooperative learning methods to students; and*
- *create positive experiences for teachers and students to engage in learning.*

For teachers to include a spatial aspect to their role to engage in students' learning, they require:
- *guidelines for practical ways to embed collaborative practices that encourage dialogue within existing learning environments;*
- *a mapping of space and furniture configurations and typologies, with evidence of their impact on engagement; and*
- *practical ways to engage students to co-create a responsive learning environment.*

#18 ILETC must consider the spatial aspects of the teacher's role to provide well-defined learning goals and outcomes (TMF8). The flexible learning environment provides teachers unique opportunities to make learning goals and success criteria visible. In order to do this, teachers must:

- *provide clear, challenging and transparent objectives and success criteria to students; and*
- *create opportunities for students to exercise their agency in using different modes of learning;*

For teachers to include a spatial aspect to their role to inform students about the impact on their learning, they need to:
- *ensure that the learning environment is appropriate to the learning tasks and goals; and*
- *be able to link the affordances in the learning environment to specific learning goals.*

Mind frame 9 is about building an atmosphere of confidence and trust, one in which students feel safe to make mistakes and learn from others. Teachers who exhibit this mind frame establish a sense of belonging and positive relationship within the students' environment, built trust with and between students, and develop a fair and positive climate in the class. The core message is that learning requires positive relationships—not only between students and teachers but also between peers. Mind frame 9 relates to the other mind frames such as mind frame 3 on collaboration, mind frame 6 on providing feedback, and mind frame 7 on communication. It also relates to the final mind frame on the language of learning as it requires a learning culture in which mistakes are welcome and are a necessary part of the learning process and not possible without established positive teacher-student relationships.

Mind frame 10 and the final mind frame is 'I focus on learning and the language of learning'. This mind frame involves teachers taking prior knowledge and experiences of the learners as the starting point for teaching. As mentioned, this requires a learning culture and importantly, developing a sense of self-concept. Teachers who demonstrate this mind frame not only keep tabs on the initial learning levels of students, but also conduct a thorough analysis of how students process information relating to their own self. This notion of self-concept relates to students' self-efficacy and motivation—both intrinsic and extrinsic.

#19

TMF 9: Teachers build relationships and trust so that learning can occur in a place where students feel safe to make mistakes and learn from others.

#20

TMF10: Teachers focus on learning and the language of learning

IMPLICATIONS FOR ILETC

#19 ILETC must consider the spatial aspects of the teacher's role to take into account the students' environment and its impact on their learning (TMF9). The flexible learning environment provides teachers unique opportunities to establish a culture of belonging and trust. In order to do this, teachers must:

- *establish a safe, fair and positive climate within the learning environment; and*
- *develop positive relationships between students and teachers and between students and their peers.*

For teachers to include a spatial aspect to their role to build a conducive environment for learning, they require:

- *spatial competency that enacts affordances of the learning environment to create positive relationships; and*
- *tools to help co-create common understandings of safe and positive use of space.*

#20 ILETC must consider the spatial aspects of the teacher's role to understand the antecedents of learning related to their students (TMF10). The flexible learning environment provides teachers unique opportunities to consider the learning tasks and goals appropriate to the learning levels of their students. In order to do this, teachers must:

- *ensure a range of teacher and pedagogical practices appropriate to the learning environment and the learning levels of students; and*
- *consider spaces with student learning in mind.*

For teachers to include a spatial aspect to their role in student learning, they need to:
- *be able to link the affordances in the learning environment to specific learning goals; and*
- *enhance their spatial competency to develop learning goals and tasks appropriate to students' prior knowledge and experiences.*

The ten mind frames are built on the notion that "people spark revolutions" (Hattie & Zierer, 2017, p. 166). It is not numbers or facts or plans, but teachers who enact change through their visions, beliefs and dreams. Teacher mind frames, which are entrenched in predetermined beliefs, biases, attitudes and values, provide crucial insight into the interactions and activities that unfold in the learning environment. Embodying specific mind frames can support the construction of inspiring and productive learning environments. The mind frames teachers adopt, therefore have a huge impact on students learning and achievement.

Defining teacher mind frames in the context of the ILETC project

Within the vast literature of teacher's cognition, a suite of terms have been used to describe teachers' thinking or thought processes. The ILETC team differentiates between teacher 'mind sets' (the epistemological beliefs held by teachers) and 'mind frames' - the mechanisms teachers consciously use to implement their beleifs. Of the latter, 'teacher beliefs' is a more commonly used term, 'teacher mind frame' has emerged as a more holistic term to describe the ways in which teachers consciously think about their teaching roles, the content and pedagogical knowledge, which in turn has an impact on their attitudes, actions and decisions that are likely to have significant impacts on student learning.

In the exploratory phase of gathering initial evidence via principals' surveys and teachers' workshops, Hattie's conceptualisations of the eight mind frames were used (Hattie, 2012). The analysis of the survey data found that as a space becomes more open (Dovey & Fisher, 2014), teacher mind frames become more positive (Imms, Mahat, Byers & Murphy, 2017). This seems to suggest that teachers are deliberate about their teaching practices and roles, cognisant of the content and pedagogical knowledge needed within the learning environment and make decisions that are likely to have positive impact on student learning. The psychometric analysis of the survey also provided initial evidence of the measuribility of the mind frame construct (Mahat & Imms 2017).

The analysis of the workshop data suggests that teacher mind frames are consistent with their teaching practices in any learning environments (Mahat, Grocott & Imms, 2017). Although teachers believe that success and failure in student learning are about what they did or did not do (mind frame 2), some of the teachers conceded that the broader environment places constraints on what they can do. This suggests that the promotion of teacher agency does not just rely on the beliefs that individual teachers bring to their practice, but also requires collective development and consideration.

In the context of the ILETC project, teacher mind frames can be defined as the ways that teachers consciously think about their teaching roles, the content and pedagogical knowledge, which in turn has an impact on their attitudes, actions and decisions that are likely to have significant impacts on student learning. This project applies Hattie's conceptualisations of teacher mind frames (2012; Hattie & Zierer, 2017), which sets the scope for the study. The set of ten mind frames—the ways teachers think about their role, their impact and their success—underpin teachers' every action and decision that impact positively on student learning. While a teacher's mind frames are essentially cognitive and behavioural in construct, the possibility exists to treat them as measurable actions.

Student deep learning

Deep and surface learning are established concepts in educational research literature. However, the conceptualisations of distinct learning approaches and the influence and interplay between individual and contextual factors has a complex history with contributions from a multitude of researchers. Beattie, Collins and Mcinnes (1997) distinguished four main groups of researchers, which have identified and explored the nature of the fundamental distinction between deep and surface approaches to learning. These research groups led by Marton, Pask, Entwistle and Biggs have explored the nature of the fundamental distinction between deep and surface approaches to learning broadly in terms of learning attributes, approaches or dimensions.

Marton and Säljö (1976) were the first to refer to the concept of the 'learning approach' which determined that different learning outcomes could be attributed to students' different learning intentions and defined these approaches as 'surface' or 'deep'. In their study of Swedish students undertaking a comprehension exercise, they found the difference between the two approaches was "whether the students focused on the text in itself or on what the text was about" (Marton & Säljö). They characterised a surface approach to learning as minimum engagement with the task, with a focus on memorisation or applying procedures without much reflection, with an intention to gain a passing grade. They found a deep approach to learning,

#21
The concept of 'learning approach' could be attributed to students' different learning intentions.

A simple distinction between surface and deep learning is based on the way students focused on the text or the meaning of text.

IMPLICATIONS FOR ILETC

(!) *#21 ILETC must consider the spatial implications of different learning goals.* An ILE should be able to accommodate varied learning tasks that can contribute to intended learning outcomes.

on the other hand, involved an intention to understand and place meaning on content. These students took an intrinsic interest in learning and understanding relationships between various elements and formulated hypotheses about the problem or concept.

Almost at the same time, Pask and Scott (1972; 1976) identified two different 'types' of learners; serialists and holists. They described serialists as step by step learners, utilising 'low order relations' to draw simplistic, sequential connections in order to remember relevant facts and information whilst holists, or global learners, actively learnt through 'high order relations', linking abstract concepts and ideas (Pask & Scott, 1972). They went further to break down holists into two subcategories: irredundant holists, those who correctly integrate and connect relevant information, and redundant holists, those who focus too intensely on niche information that is excessively specific, or irrelevant.

Studies led by Entwistle in the 1970's aimed to identify student attributes which could be used to predict academic success measured in terms of degree classifications, such as personality, motivational, and study method variables (Entwistle, Thompson & Wilson, 1974; Entwistle & Wilson, 1970, 1977). Entwistle and Brennan (1971) used cluster analysis to identify 'types of successful students' based on student profiles and causal paths that predict academic achievement or failure. Further studies by Entwistle and colleagues (Entwistle, 1977; Entwistle & Brennan, 1971; Entwistle, Hanley, & Hounsell, 1979; Entwistle, Thompson & Wilson, 1974) built on this by framing the learning process to be inherently fixed and interdependent on predictive personality traits. Their later studies conducted between 1975 and 1980 were influenced by works conducted by research groups led by Marton and Pask, which recognised the potential influence of external factors on the learning approach adopted by students.

In a later study, Ramsden and Entwistle (1981) categorised their approaches to studying based on three orientations of personal meaning, reproducing, and

IMPLICATIONS FOR ILETC

#22 ILETC must consider the spatial implications of different types of learners. An innovative learning environment should be able to accommodate the learning styles of different types of learners. It is student-centred.

achieving. Learners with a reproducing orientation utilised a surface approach, preoccupied with syllabus requirements experienced a subsequent fear of failure and were motivated only by extrinsic means. While learners with a 'meaning' orientation, took a deeper approach—have a genuine interest, were driven by intrinsic motivations, have capacity to integrate ideas and ability to connect evidence and develop logical conclusions. The achieving orientation is characterised by organised study methods and achievement motivation. Unlike Marton and Säljö (1976) who conceptualised learning approaches on a continuum, Ramsden and Entwistle (1981) maintained that predispositions to adopt certain approaches were indicative of specific traits.

Biggs (1970) also explored correlations between personality traits and learning achievement focusing on the traits prevalent in students. He found two main classes of study strategy: 'simplifying' strategies, and 'opening-out' strategies. While opening-out strategies are described as adaptive, more sophisticated and requiring complex thought, simplifying strategies include unquestioning acceptance and assimilation of facts without further comprehension, lack of dogmatism, tolerance of ambiguity and independence. Interestingly, these strategies are reminiscent of what we now call surface and deep learning. Surface learning could be described simply as "typical of the student with 'pass only' aspirations", while deep learning could be described as "efficient, if low level, methods of coping with unstructured course material" (Biggs, p. 171).

Learning dimensions are defined through student study strategies of utilising (surface), internalising (deep) and achieving.

Further studies by Biggs (1978, 1979) later identified learning dimensions of utilising, internalising, and achieving, which he later renamed to surface, deep, and achieving, respectively, to provide consistency with the work of other scholars in the field (Biggs, 1987). He defined deep and surface approaches as ways in which students engaged in the context of the specific task to be accomplished, while the 'achieving' approach involved students organising their time and working environment. He contended that it is possible for students to adopt mixed approaches to learning, for example deep-achieving and surface-deep. Biggs (1987) also extended his model of student learning to advance the concept of metacognition, which he defined as an individual's awareness of his or her cognitive resources.

More recent research has moved beyond the simple dichotomy of surface and deep learning and are embracing "super skills" for the 21st Century (P21, 2015). These skills include the four C's of Creativity, Communication, Critical Thinking and Collaboration. These learning and innovation skills are increasingly being recognised as the skills that are required of students to be prepared for the complex life and work environments in the 21st century.

A focus on creativity, critical thinking, communication and collaboration "help develop the qualities that students need to possess in the 21st century for success" (Saxena, 2014).

- Creativity – To think creatively, work creatively with others and implement innovations;
- Communication – To articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts;
- Critical Thinking – To reason effectively, use systems thinking, make judgments and decisions, and solve problems; and
- Collaboration – Demonstrate ability to work effectively and respectfully with diverse teams.

Fullan and Langworthy (2014) have adapted previously established definitions of deep learning to include digital technologies and notions of 'learning leadership'. They describe deep learners as those empowered to have autonomy over their own education, being 'leaders of their own learning' with the resources that digital connection and accessibility provides (Fullan & Langworthy, 2014). They see students with deep learning tendencies developing "the learning, creating and 'doing' dispositions that young people need to thrive now and in their futures", and is "defined as 'creating and using new knowledge in the world'" (Fullan & Langworthy, 2014, p. 3). This, they explain, entails seeking feedback from peers and teachers, using digital learning tools in creative ways, pursuing passions in learning goals, creating trusting relationships that encourage reciprocal learning, and development of attitudes that propel the search for knowledge. They explored these new conceptualisations through the notion of the 6Cs:

- Character - honesty, self-regulation and responsibility, hard work, perseverance, empathy for contributing to the safety and benefit of others, self-confidence, personal health and well-being, career and life skills.
- Citizenship - global knowledge, sensitivity to and respect for other cultures, active involvement in addressing issues of human and environmental sustainability.

- Communication - communicate effectively orally, in writing and with a variety of digital tools; listening skills.
- Critical thinking and problem solving - think critically to design and manage projects, solve problems, make effective decisions using a variety of digital tools and resources.
- Collaboration - work in teams, learn from and contribute to the learning of others, social networking skills, empathy in working with diverse others.
- Creativity and imagination - economic and social entrepreneurialism, considering and pursuing novel ideas, and leadership for action (Fullan & Langworthy, 2014).

Governments around the world have also incorporated sets of learning skills that are expected of students. The Australian Curriculum, for instance, sets the 'general capabilities'—encompassing knowledge, skills, behaviours and dispositions—that equip young Australians to live and work successfully in the 21st century (ACARA, 2010). The New Zealand Ministry of Education lists Self-directed, Empathetic and inclusive, Innovative, Collaborative, Authentic problem solving, and STEM foundation for all as key attributes of learning (New Zealand Ministry of Education, 2015a).

While some scholars and practitioners have criticised the simplistic and oversimplified approach to characterising student learning (see example of Tormey, 2014), many others have continued to support characterisation of deep and surface learning as distinct approaches to student learning (Chang & Chang, 2008; Hall, Ramsay, & Raven, 2004; Hattie & Donoghue, 2016; Prosser & Trigwell, 1998; Ramsden, 1992). In the main, the literature has espoused that high quality learning outcomes are associated with deep approaches whereas low-quality outcomes are associated with surface approaches (Biggs, 1987; Entwistle, 2001; Marton & Säljö, 1984).

Much research has focused on these distinct approaches in a range of learning settings and fields of education, and has demonstrated that a student's approach

#23
A variety of conceptualisations have been used to describe students' learning approaches and skills required for the 21st century.

IMPLICATIONS FOR ILETC

#23 ILETC accepts the 21st century skills as a practical concept. While ILETC acknowledges the different conceptualisations of learning skills, a targeted focus on the 4Cs provides sufficient scope for this project. ILETC focus is, unashamedly, on teachers. An extended definition that provides the breadth and depth of learning skills should be included in future studies that focus on student engagement with ILEs.

to learning is only partly a function of his or her general characteristics, and can be modified by specific learning situations. This implies that deep learning is rarely fully achieved, with students operating across a surface-to-deep learning continuum, depending on learning situations and contexts (Postareff, Parpala & Lindblom-Ylänne, 2015). More recently, scholars and policy makers have advanced the notion of skills required in the 21st century. Coined as 4Cs or 6Cs, these are the skills students need to develop for an increasingly complex world.

iletc   IMPLICATIONS FOR ILETC

#24 ILETC must consider the spatial implications of different teaching practices. An innovative learning environment should be able to accommodate teaching practices that can contribute to learning along the surface-deep continuum.

Defining student deep learning in the context of the ILETC project

As can be seen from research conducted over decades, student learning approaches can be conceptualised in different ways. Generally, student deep learning can be encouraged through the delivery of rich core content to students in ways that allow them to learn and then apply what they have learned. A simple characterisation of student learning approaches of surface versus deep has been found to be the most effective means for monitoring teaching and learning environments and more useful in addressing the most important parameters relating to teaching and learning quality. Increasingly, there is a notion that deep learners are those that are empowered to take autonomy over their own learning—active, responsible participants in their own learning, as well as with their own pace of learning.

In the Space, Design & Use survey (Imms et al., 2017), the project adapted the Learning Process Questionnaire (Biggs, 1987; Biggs, Kember, & Leung, 2004), which measures deep and surface approaches to learning within the 'systems theory' of student approaches to learning. Ten items from the Deep Approach Scale that describe ways in which students engage in the context of the specific task to be accomplished, were included in the survey. Validity and reliability analyses of the deep learning scale have shown that the scale is reliable, valid and stable (Mahat & Imms, 2017).

Analyses of the workshop data show that teachers define student deep learning as displaying creativity, critical thinking, character, collaboration, citizenship, and learner as teacher (Mahat, Grocott & Imms, 2017). Interestingly, communication was not explicitly acknowledged as a characteristic of deep learning by participants. The notion of 'learner as teacher' is about the manner in which a student takes an active, responsible role in their own learning.

In the context of the ILETC project, student deep learning—as triangulated from data from the survey, workshops and literature—can be attained when students actively engage in critical learning. This is characterised by: critically applying new facts to existing knowledge, searching for (as opposed to accepting) meaning, being actively curious about new knowledge, and accepting that learning is a part of their personal development. This definition accepts that deep learning is rarely fully achieved, with students operating across a surface-to-deep learning continuum. Deep learning is often present when students display strong creativity, critical thinking, collaboration, and communication skills – the so-called '4C's. These 21st century skills are foundational elements for students' success in a highly connected, knowledge-based and complex world.

South Melbourne Primary School, Hayball Architecture, Diana Snape photography.

Where to now?

This report presents a critique of the literature concerning the key concepts relevant to the ILETC project. It is an evaluative report of information found in the literature related to the study's foci, and provides a 'working' theoretical and conceptual base for the project's research. By synthesising this literature with quantitative and qualitative findings from the Phase 1 survey (Imms et al., 2017) and teacher workshops (Mahat et al., 2017), this paper advances definitions and characteristics of key concepts pertinent to the project.

What this report does not tell us however, is whether there is any evidence of the impacts of learning environments on the key variables of teacher mind frames and student deep learning. Consequently, the project is conducting a series of three systematic reviews with the broad aim of establishing gaps in current knowledge that ILETC will address. The three systematic reviews focus on a key research question: What evidence exists that learning environments have an impact on: (1) teacher mind frames; (2) student deep learning; and (3) student learning outcomes?

All graduate researchers and research fellows were involved in the systematic reviews, with key input from Chief Investigators at various stages of the reviews. The systematic reviews began by trialling a series of searches using search terms identified from the PhD literature reviews that were the source for this Technical Report. Those systematic reviews continue to be conducted as this report is written; refined search results have been exported into Endnote and reviewed in Covidence, firstly by title and abstract and then by full text. The eligible full text articles from each focus area are then being assessed for quality. The information gained from remaining articles is creating one component of an evidence base for our project's understanding of teacher mind frames, student deep learning and student outcomes in relation to ILEs. This important exercise has further informed and guided the project's conceptualisations of Phases 2 and 3 of the ILETC project. From the systematic reviews, three Technical Reports will be published concerning their results, and from these a suite of scholarly publications will discuss their implication for

ILETC and the wider learning environments field.

The ongoing transition from traditional classrooms to ILEs in Australia and New Zealand cannot be halted—these spaces offer the teacher and learner an array of educational opportunities previously denied by largely mono-typed learning spaces. What is required is evidence concerning the impact of this transition. To that end, syntheses of scholarly based evidence, such as those documented in this report, provide a critical analysis of published articles on key concepts relevant to the ILETC project and the field. The integration of quantitative and qualitative data collected as part of Phase 1 of the project, provides a strong and robust knowledge base that responds to the project's initial assumptions surrounding the use of innovative learning environments in Australia and New Zealand.

References

ACARA (2010). General capabilities. Retrieved from https://www.australiancurriculum.edu.au/f-10-curriculum/ general-capabilities. Accessed: 27 February 2018.

Akhtar, J., Anjum, N., & Iftikhar, N. (2013). Evaluation of the impact of noise pollution on students in congested area of Rawalpindi. *Nurture, 7*(1), 9-17.

Alfieri, L., Brooks, P. J., Aldrich, N. J., & Tenenbaum, H. R. (2010). Does discovery-based instruction enhance learning? *Journal of Educational Psychology 103*(1), 1–18.

Bateman, D. (2009). Playing with Reggio spaces in higher education for teacher education, *in AARE 2009 : Australian Association for Research in Education International Education Research Conference*, Australian Association for Research in Education, Melbourne, Vic.

Beare, H. (2001). *Creating the future school*. London and New York: RoutledgeFalmer.

Beattie, V., Collins, B., & Mcinnes, B. (1997). Deep and surface learning: a simple or simplistic dichotomy? *Accounting Education, 6*(1), 1-12.

Beere, J. (2013). *The Perfect Teacher*. Carmarthen, Wales: Crown House Publishing.

Biggs, J. B. (1970). Faculty patterns in study behaviour. *Australian Journal of Psychology, 22*(2), 161-174. doi:10.1080/00049537008254570

Biggs, J. B. (1978). Individual and group differences in study processes. *British Journal of Educational Psychology, 48*, 266-279.

Biggs, J. B. (1979). Individual Differences in Study Processes and the Quality of Learning Outcomes. *Higher Education, 8*(4), 381-394.

Biggs, J. B. (1987). *Student Approaches to Learning and Studying. Research Monograph*. Hawthorn: Australian Council for Educational Research.

Biggs, J., Kember, D., & Leung, D. P. (2001). The revised two-factor Study Process Questionnaire: R-SPQ-2F. *British Journal of Educational Psychology, (1)*. 133.

Blackmore, J., Bateman, D., Loughlin, J., O'Mara, J., & Aranda, G. (2011). *Research into the connection between built learning spaces and student outcomes: Literature review*. Melbourne: Victorian Department of Education and Early Childhood Development. Retrieved from www.eduweb.vic.gov.au/edulibrary/public/publ/ research/publ/ blackmore_learning_spaces.pdf

Boys, J. (2009). Beyond the beanbag? Towards new ways of thinking about learning spaces. *Networks, 8*.

Brown, C. A., & Cooney, T. J. (1982). Research on Teacher Education: A Philosophical Orientation. *Journal of research and Development in Education, 15*(4), 13-18.

Buckley, J., Schneider, M., & Shang, Y. (2005). Fix it and they might stay: School facility quality and teacher retention in Washington, DC. *Teachers College Record, 107*(5), 1107-1123.

Butin, D. (2000). Multipurpose Spaces. National Clearinghouse for Educational Facilities, Washington, DC. Retrieved from https://files.eric.ed.gov/fulltext/ED446423.pdf.

Bybee, R. W. (1993). *Reforming Science Education. Social Perspectives & Personal Reflections*. New York: Teachers College Press.

Chang, S., & Chang, Y. (2008). Using Concept Mapping With Peer Learning to Enhance Concept Learning. *The Quarterly Review of Distance Education, 9*(1), 17-28.

Chapman, A., Randell-Moon, H., Campbell, M., & Drew, C. (2014). Students in space: Student practices in non-traditional classrooms. *Global Studies of Childhood, 4*(1), 39-48.

Chappuis, S., & Stiggins, R. J. (2002). Classroom assessment for learning. *Educational leadership, 60*(1), 40-44.

Chism, N. (2005), "Informal learning spaces and the institutional mission", Proceedings of the EDUCAUSE Learning Initiative, ELI Fall 2005 Fall Focus Session, Avondale, AZ, September 14-15. Retrieved from www.educause.edu/eli054

Central Advisory Council for Education (1967). *The Plowden Report, Children and their Primary Schools*. London: HMSO.

Clark, C. M. (1988). Asking the right questions about teacher preparation: Contributions of research on teacher thinking. *Educational Researcher, 17*(2), 5-12.

Clark, C. M., & Yinger, R. J. (1977). Research on teacher thinking. *Curriculum inquiry, 7*(4), 279-304.

Clarke, H. (2001). *Building education: The role of the physical environment in enhancing teaching and learning.* Paper presented at the British Educational Research Association annual conference, University of Leeds.

Collin, R., & Apple, M. W. (2010). New literacies and new rebellions in the global age. In Apple, M.W. (Ed.), *Global crises, social justice, and education*, 25-60. New York: Routledge.

Czarapata, P. B.& Friskney (2014). *Faculty perceptions of learning spaces.* (3619808 Ed.D.), Morehead State University, Ann Arbor. Retrieved from http://search.proquest.com.ezp.lib.unimelb.edu.au/docview/1537051345?accountid=12372

Dovey, K., & Fisher, K. (2014). Designing for adaptation: the school as socio-spatial assemblage. *The Journal of Architecture, 19*(1), 43-63.

Dudek, M. (2000). *Architecture of schools: The new learning environments*. Oxford, Boston: Routledge.

Dumont, H., Istance, D., & Benavides, F. (2010). *The nature of learning: Using research to inspire practice*. Retrieved from http://www.oecd.org/education/ceri/49825988.pdf

Dweck, C. S. (2006). Mindset: *The new psychology of success*. New York: Random House Incorporated.

Dwyer, D. C., Ringstaff, C., Haymore, J., & Sandholtz, P. (1994). Apple classrooms of tomorrow. *Educational leadership, 51*(7), 4-10.

Edwards, R., & Clarke, J. (2002). Flexible Learning, Spatiality and Identity. *Studies in Continuing Education, 24*(2), 153-165. doi:10.1080/0158037022000020965

Eells, R. (2011), *Meta-analysis of the relationship between collective efficacy and student achievement*. Unpublished Ph.D dissertation. Loyola University of Chicago.

Elliott, L. L. (1979). Performance of children aged 9 to 17 years on a test of speech intelligibility in noise using sentence material with controlled word predictability. *The Journal of the Acoustical Society of America, 66*(3), 651-653.

Entwistle, N. J. (1977). Strategies of Learning and Studying: Recent Research Findings. *British Journal of Educational Studies, 25*(3), 225-238. doi:10.2307/3120694

Entwistle, N. J. (2001). Styles of learning and approaches to studying in higher education. *Kybernetes, 30*(5/6). 593-603. https://doi.org/10.1108/03684920110391823

Entwistle, N. J., & Brennan, T. (1971). The academic performance of students. *British Journal of Educational Psychology, 41*(3), 268-276. doi:10.1111/j.2044-8279.1971.tb00671.x

Entwistle, N. J., Hanley, M., & Hounsell, D. (1979). Identifying Distinctive Approaches to Studying. *Higher Education, 8*(4), 365-380.

Entwistle, N. J., Thompson, J. B., & Wilson, J. D. (1974). Motivation and Study Habits. *Higher Education, 3*(4), 379-395.

Entwistle, N. J., & Ramsden, P. (1983). *Understanding student learning*. London: Croom Helm.

Entwistle, N. J., & Wilson, J. D. (1970). Personality, study methods and academic performance. *University Quarterly, 21*, 147-166.

Entwistle, N. J., & Wilson, J. D. (1977). *Degrees of Excellence: the Academic Achievement Game*. London: Hodder & Stoughton.

Fisher, K. (2005). Research into identifying effective learning environments. *Evaluating quality in educational facilities, 9*, 159-167.

Fuchs, L. S., & Fuchs, D. (1986). Effects of systematic formative evaluation: A meta-analysis. *Exceptional children, 53*(3), 199-208.

Fullan, M. (1993). Why teachers must become change agents. *Educational leadership, 50*, 12-12.

Fullan, M., & Langworthy, M. (2014). *A rich seam: How new pedagogies find deep learning*. London: Pearson. Retrieved from https://www.michaelfullan.ca/wp-content/uploads/ 2014/01/3897.Rich_Seam_web.pdf

Hall, M., Ramsay, A., & Raven, J. (2004). Changing the learning environment to promote deep learning approaches in first-year accounting students. *Accounting Education, 13*(4), 489-505.

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. London and New York:Routledge.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. London and New York: Routledge.

Hattie, J., & Donoghue, G. M. (2016). Learning strategies: A synthesis and conceptual model. *Science of Learning, 1*, 1-13. doi:10.1038/npjscilearn.2016.13

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of educational research*, *77*(1), 81-112.

Higgins, M., & Reeves, D. (2006). Creative thinking in planning: How do we climb outside the box? *The Town Planning Review, 77*(2), 221-244.

Hattie, J., & Zierer, K. (2018). *10 Mindframes for Visible Learning*. New York and Abingdon, Oxon: Routledge.

Hill, C. H. (1971). Teachers as change agents. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 45*(7), 424-428.

Imms, W. (in press). Innovative learning spaces: Catalysts/agents for change, or 'just another fad'? In S. Alterator & C. Deed (Eds.). *School space and its occupation: The conceptualisation and evaluation of new generation learning spaces*. Rotterdam: Sense Publishers.

Imms, W., Cleveland, B., & Fisher, K. E. (2016). *Evalutating learning environments. Snapshots of emerging issues, methods and knowledge*. Rotterdam: Sense Publishing.

Imms, W., Mahat, M., Byers, T., & Murphy, D. (2017). *Type and Use of Innovative Learning Environments in Australasian Schools ILETC Survey No. 1*. Melbourne: University of Melbourne, LEaRN, Retrieved from http://www.iletc.com.au/publications/reports

Istance, D. (2018). *Schooling Redesigned: Towards Innovative Learning Systems*. Retrieved from http://dx.doi.org.ezp.lib.unimelb.edu.au/10.1787/9789264245914-en.

JISC. (2006). *Designing spaces for effective learning*. *UK: HEFCE*. Retrieved from www.jisc.ac.uk/eli_learningspaces.html

Johnson, C. E. (2000). Children's phoneme identification in reverberation and noise. *Journal of Speech, Language & Hearing Research, 43*(1), 144-157.

Kagan, D. M. (1992). Implication of research on teacher belief. *Educational Psychologist, 27*(1), 65-90.

Katzenmeyer, M., & Moller, G. (2009). *Awakening the sleeping giant: Helping teachers develop as leaders*. California: Corwin Press.

Kember, D., Biggs, J., & Leung, D. Y. (2004). Examining the multidimensionality of approaches to learning through the development of a revised version of the Learning Process Questionnaire. *British Journal of Educational Psychology, 74*(2), 261-279

Klatte, M., Hellbrück, J., Seidel, J., & Leistner, P. (2010). Effects of Classroom Acoustics on Performance and Well-Being in Elementary School Children: A Field Study. *Environment and Behavior, 42*(5), 659.

Lackney, J. A. (1999). *Assessing School Facilities for Learning/Assessing the Impact of the Physical Environment on the Educational Process: Integrating Theoretical Issues with Practical Concerns*. Mississippi. Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED441330.

Lefebvre, H. (1991). *The production of space* (Vol. 142). Oxford: Blackwell.

Leiringer, R., & Cardellino, P. (2011). Schools for the twenty-first century: School design and educational transformation. *British Educational Research Journal, 37*(6), 915-934. doi:10.1080/01411926.2010.508512

Leung, C., & Mohan, B. (2004). Teacher formative assessment and talk in classroom contexts: assessment as discourse and assessment of discourse. *Language Testing, 21*(3), 335-359. doi:http://dx.doi.org/10.1191/0265532204lt287oa

Locke, E. A., & Latham, G. P. (1990). Work motivation and satisfaction: Light at the End of the Tunnel. *Psychological Science (0956-7976), 1*(4), 240-246.

Lomas, C., & Oblinger, D.G. (2006). Chapter 5. Student practices and their impact on learning spaces In. D.G. Oblinger (Ed.), *Learning Spaces*. Retrieved from: https://www.educause.edu/research-and-publications/books/learning-spaces/chapter-5-student-practices-and-their-impact-learning-spaces

Mahat, M., Grocott, L., & Imms, W. (2017). *"In the real world..." Teachers' perceptions of ILEs. ILETC phase 1 teacher workshops*. Melbourne: University of Melbourne, LEaRN, Retrieved from: http://www.iletc.com.au/publications/reports

Mahat, M., & Imms, W. (2017). The development of a sampling frame to investigate teacher practices and student learning in 'traditional' and 'non-traditional' learning spaces. Paper presented at the AARE 2017, Canberra: Australian Association for Research in Education International Education Research Conference.

Marton, F., & Säljö, R. (1976). On qualitative differences in learning: I—Outcome and process. *British Journal of Educational Psychology, 46*(1), 4-11. doi:10.1111/j.2044-8279.1976.tb02980.x

Massey, D. (1994). *Space, Place, and Gender* (NED - New edition ed.). Minnesota: University of Minnesota Press.

Massey, D. (2005). *For space*. London: Sage.

MCEETYA (2008). *Melbourne declaration on educational goals for young Australians*. Retrieved from http://www.curriculum.edu.au/verve/_resources/ National_ Declaration_on_the_Educational_ Goals_for_Young_ Australians.pdf

McLaughlin, P., & Faulkner, J. (2012). Flexible spaces ... what students expect from university facilities. *Journal of Facilities Management, 10*(2), 140-149. doi:http://dx.doi.org/10.1108/14725961211218776

Monahan, T. (2000). *Built pedagogies & technology practices: Designing for participatory learning.* Paper presented at the Participatory Design Conference, Palo Alto, CA.

Mulcahy, D., Cleveland, B., & Aberton, H. (2015). Learning spaces and pedagogic change: Envisioned, enacted and experienced. *Pedagogy, Culture & Society, 23*(4), 575-595.

Munby, H. (1984). A qualitative approach to the study of a teacher's beliefs. *Journal of Research in Science Teaching, 21*(1), 27-38. doi:10.1002/tea.3660210104

Neill, S., & Etheridge, R. (2008). Flexible learning spaces: The integration of pedagogy, physical design, and instructional technology. *Marketing Education Review, 18*(1), 47-53.

Nelson, P., Kohnert, K., Sabur, S., & Shaw, D. (2005). Classroom Noise and Children Learning Through a Second Language: Double Jeopardy? *Language, Speech & Hearing Services in Schools, 36*(3), 219-229.

New Zealand Ministry of Education (2015a). *New Zealand in 2025: Lifelong learners in a connected world*. Retreived from: https://www.education.govt.nz/assets/Documents/ Ministry/Initiatives/Lifelonglearners.pdf

New Zealand Ministry of Education. (2015b). *Spaces, storage, equipment*. Retrieved from http://www.education.govt.nz/school/property/state-schools/design-standards/flexible-learning-spaces/spaces-storage-equipment/

New Zealand Ministry of Education (2018a). *Design standards for school property*. Retrieved from http://www.education.govt.nz/school/property/state-schools/design-standards/

New Zealand Ministry of Education (2018b). *Innovative Learning Environments*. Retreived from: http://elearning.tki.org.nz/Teaching/Innovative-learning-environments

Oblinger, D., & Lippincott, J. K. (2006). Learning spaces. (various pagings): illustrations. Retrieved from https://www.educause.edu/ir/library/pdf/PUB7102.pdf

Oblinger, D. G. (2006). Space as change agent. In D.G. Oblinger (Ed.) *Learning spaces*. Retrieved from https://www.educause.edu/ir/library/pdf/PUB7102.pdf

OECD. (2006). *Evaluating quality in educational facilities*. Retrieved from http://www.oecd.org/education/innovation-education/ evaluatingqualityineducationalfacilities.htm.

OECD. (2015). *Schooling redesigned: Towards innovative learning systems*. Education Research and Innovation. Paris: OECD Publishing. Retrieved from http://www.oecd.org/education/schooling-redesigned-9789264245914-en.htm

OECD. (2017). *The OECD Handbook for Innovative Learning Environments*. Retrieved from http://www.oecd.org/education/the-oecd-handbook-for-innovative-learning-environments-9789264277274-en.htm

Osborne, M. (2016). Innovative learning environments. *CORE Education White Paper*. Retrieved from http://www.core-ed.org/legacy/sites/core-ed.org/files/Innovative-Learning-Environments-FINAL-web.pdf?url=/sites/core-ed.org/files/Innovative-Learning-Environments-FINAL-web.pdf

P21. (2016). Framework for 21st Century Learning. The Partnership for 21st Century Skills. Retrieved from http://www.p21.org/about-us/p21-framework

Pajares, M. F. (1992). Teachers' Beliefs and Educational Research: Cleaning up a Messy Construct. *Review of Educational Research, 62*(3), 307-332. doi:10.2307/1170741

Pask, G. (1976), Styles and Strategies of Learning. *British Journal of Educational Psychology, 46*. 128–148. doi:10.1111/j.2044-8279.1976.tb02305.x

Pask, G., & Scott, B. C. E. (1972). Learning strategies and individual competence. *International Journal of Man-Machine Studies, 4*(3), 217-253. doi:http://dx.doi.org/10.1016/S0020-7373(72)80004-X

Postareff, L., Parpala, A., & Lindblom-Ylänne, S. (2015). Factors contributing to changes in a deep approach to learning in different learning environments. *Learning Environments Research, 18*(3), 315-333.

Prain, V., Cox, P., Deed, C., Edwards, D., Farrelly, C., Keeffe, M., . . . Waldrip, B. (2015). *Personalising learning in open-plan schools*: Rotterdam, Netherlands: Sense Publications.

Prosser, M., & Trigwell, K. (1998). *Teaching for learning in higher education.* Buckingham: Open University Press.

Ramsden, P. (1992). *Learning to teach in higher education*. London: Routledge.

Ramsden, P., & Entwistle, N. J. (1981). Effects of academic departments on students' approaches to studying. *British Journal of Educational Psychology, 51*(3), 368-383. doi:10.1111/j.2044-8279.1981.tb02493.x

Rinaldi, C. (2006). *In dialogue with Reggio Emilia: Listening, researching and learning*: London and New York: Routledge.

Rowe, J. P., Shores, L. R., Mott, B. W., & Lester, J. C. (2011). Integrating learning, problem solving, and engagement in narrative-centered learning environments. *International Journal of Artificial Intelligence in Education, 21*(1-2), 115-133.

Rowe, K. (2003). The importance of teacher quality as a key determinant of students' experiences and outcomes of schooling. In M. Meiers (Ed.), *Building teacher quality: Research conference 2003 proceedings* (pp. 15-23). Melbourne: ACER. Retrieved from: https://research.acer.edu.au/research_conference_2003/3/

Royle, K., Stager, S., & Traxler, J. (2014). Teacher development with mobiles: Comparative critical factors. *Prospects, 44*(1), 29-42.

Saltmarsh, S., Chapman, A., Campbell, M., & Drew, C. (2015). Putting "structure within the space": spatially un/responsive pedagogic practices in open-plan learning environments. *Educational Review, 67*(3), 315-327.

Sanoff, H. (1995). Creating environments for young children. School of Design, North Carolina State University. Retrieved from https://eric.ed.gov/?id=ED394640

Saxena, S. (2014). How Do You Teach the 4Cs to Students (Part-1): Creativity and Innovation? [Blog post]. Retrieved from http://edtechreview.in/trends-insights/insights/914-how-do-you-teach-the-4Cs-to-students-part-1-creativity-and-innovation

Scriven, M. (1967). The methodology of evaluation. In R. W. Tyler, R. M. Gagne, & M. Scriven (Eds.), *Perspectives of curriculum evaluation* (pp. 39-83). Chicago, IL: Rand McNally.

Selwyn, N. (2014). Education and 'the digital'. *British Journal of Sociology of Education, 35*(1), 155-164.

Smith, T. K. (2014). Elementary Science Instruction: Examining a virtual environment for evidence of learning, engagement, and 21st century competencies. *Education Sciences, 4*(1), 122-138. doi:http://dx.doi.org/10.3390/educsci4010122

Soli, S. D., & Sullivan, J. A. (1997). Factors affecting children's speech communication in classrooms. *The Journal of the Acoustical Society of America, 101*(5), 3070-3070. doi:10.1121/1.418755

Stelmachowicz, P. G., Hoover, B. M., Lewis, D. E., Kortekaas, R. W., & Pittman, A. L. (2000). The relation between stimulus context, speech audibility, and perception for normal-hearing and hearing-impaired children. *Journal of Speech, Language, and Hearing Research, 43*(4), 902-914.

Tobin, K. (1990). Teacher mind frames and science learning. In K. Tobin, J.B. Kahle, B.J. Fraser (Eds.), *Windows into science classrooms: Problems associated with higher-level cognitive learning* (pp. 33-91). London: Falmer Press.

Tormey, R. (2014). The centre cannot hold: untangling two different trajectories of the 'approaches to learning' framework. *Teaching in Higher Education, 19*(1), 1-12. doi:10.1080/13562517.2013.827648

World Economic Forum (2018). *Towards a reskilling revolution: A Future of Jobs for All*. Geneva: World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_FOW_Reskilling_Revolution.pdf

Our partners